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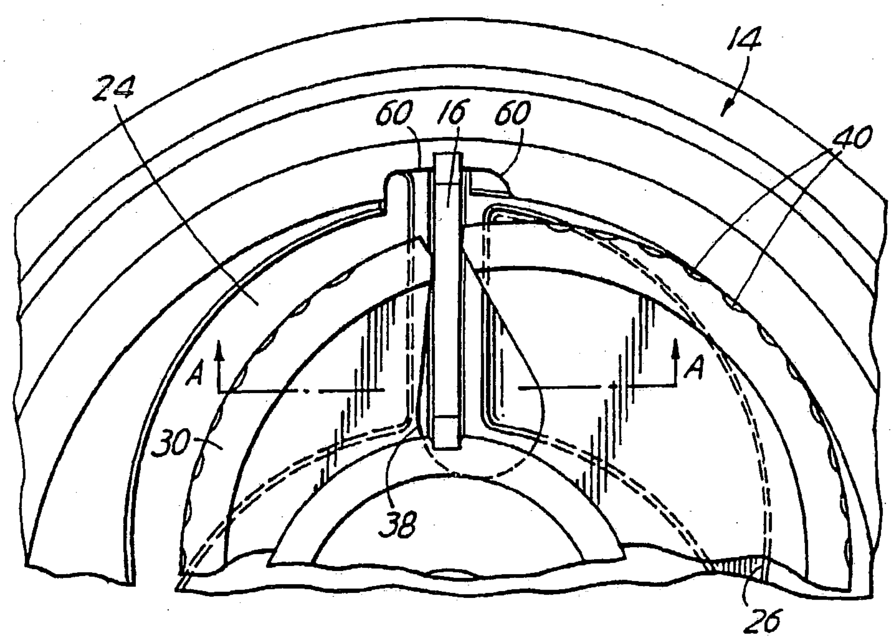

(57) Abstract

A water meter of the volumetric type has a piston eccentrically mounted in a chamber to sweep a fixed volume between inlet and outlet ports. Axially extending grooves are formed in the sealing surface of the piston to enable suspended particles to pass without damage through the meter, whilst maintaining a sufficient seal to ensure accuracy. The grooves communicate through a flush channel with the outlet port.

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Rotary piston water meter

This invention relates to water meters and particularly to volumetric or semi-positive water meters.

Typically, a volumetric water meter comprises an eccentric piston oscillating within a chamber which has inlet and outlet ports. The piston is in sealing engagement within the chamber and sweeps a known volume as fluid passes from the inlet to the outlet port. If the movement of the piston is to reflect accurately the flow of fluid through the meter, there must be very close engagement between the piston and the internal wall of the chamber. This can cause difficulty in circumstances where the fluid carries solid particles. It is not unusual, for example, for water supplies to carry occasional particles of grit. These particles will, if trapped between the piston and the internal chamber wall, increase friction and may cause abnormal wear. There is under these circumstances a real risk that the accuracy of the meter will fall below a tolerable level.

It is an object of this invention to provide an improved volumetric water meter which can accommodate a reasonable level of particulate matter without undue loss of accuracy.

Accordingly, the present invention consists in a water meter comprising a cylindrical chamber having a fluid inlet port and a fluid outlet port and a piston eccentrically disposed within the chamber and having a cylindrical piston wall in sealing engagement with the cylindrical wall of the chamber such that generally cicumferential movement of the piston

relative to the chamber sweeps a fixed volume of water passing from the inlet to the outlet port, characterised in that one of the said cylindrical piston wall and the said cylindrical chamber wall is provided with a plurality of recesses spaced circumferentially, each recess opening to the chamber so as to provide a pathway for particulate matter carried by the water, without significant impairment of said sealing engagement.

Advantageously, flush channel means communicate between said pathway and the fluid outlet port.

Preferably, said recesses comprise axially directed grooves.

Suitably, said grooves are formed in a radially outwardly directed surface of the piston.

According to a preferred feature of the present invention, there is provided in the interior wall of the chamber, an axially extending slot which communicates with said recesses downstream of said sealing engagement and which connects with the outlet port to facilitate flushing of particulate matter.

The most important application of meters according to the present invention is the metering of portable water supplies.

It will be understood that, at a simplistic level, one way of preventing solid particles from becoming trapped between the oscillating piston and the interior chamber wall, is to increase the size of the gap between the piston and the wall. This would of course create a leakage path between the inlet and outlet ports and such an arrangement is not practicable. By providing a series of recesses in either the piston wall or the wall of the chamber with which the piston is in sealing engagement, the present invention may be regarded as providing a "virtual" increase in the size of the gap. Because the contact area between the piston and the chamber wall is substantially reduced, preferably by at least 50% and ideally around 70%, the probability of particles becoming trapped is proportionately reduced. Each recess as it passes from the upstream to the downstream side of the line of seal represents a pathway for solid particles, the gap being increased at these points only.

Most surprisingly, the provision of recesses is found not to impair - to any significant extent - the sealing engagement between the piston and the chamber wall. It is believed that the maintenance of an effective seal despite the presence of the recesses arises in the following manner. As each recess passes from the upstream to the downstream side of the line of seal,

there is a sequential contraction and expansion. The consequential dissipation of kinetic energy results in a reduction of the pressure drop across the seal. With the lower pressure drop, there is a reduction in leakage past the seal. It is observed that this phenomenon causes no loss of torque and does not reduce the ability of the piston to drive a register. It is also observed that as the flow rate increases, the entrapment of water in the grooves cushions the piston against the chamber wall thus reducing friction and providing lower wear.

The recesses may take the form of axially extending grooves in the cylindrical outer surface of the piston. These grooves will preferably extend over the entire or substantially the entire axial length of the piston and will be provided around the entire periphery of the piston. Alternatively, grooves may be formed in that part of the chamber wall which is in sealing engagement with the piston.

In a typical arrangement, a volumetric water meter has a piston sweeping an annular space betweena cylindrical wall and a cylindrical chamber hub. There will usually be engagement both between the outer surface of the piston and the cylindrical chamber wall, as well as between an inner piston surface and the cylindrical chamber hub. A design choice is made as to which of these engagements serves as the metering seal. In such an arrangement, a further alternative within the present invention provides recesses in either the cylindrical piston wall or the cylindrical chamber hub.

The present invention will now be described by way of example with reference to the accompanying drawings, in which :-

Figure 1 is an exploded view of a known volumetric water meter;

Figures 2a) to 2d) are a series of diagrams illustrating the manner of operation of the water meter shown in Figure 1;

Figure 3 is a plan view of a piston forming part of a water meter according to one embodiment of the present invention;

Figure 4 is a portion of Figure 3 shown to an enlarged scale;

Figure 5 is a front view of the piston shown in Figures 3 and 4;

Figure 6 is a view similar to Figure 3, illustrating the operation;

Figure 7 is a cross-sectional view through a water meter incorporating the piston of Figure 3;

Figure 8 is a section on line A-A of Figure 7;

Figure 9 is a perspective view illustrating a modification;

Figure 10 is a view similar to Figure 7 of a meter according to a further embodiment of the present invention; and

Figure 11 is a view in the direction B of Figure 10.

Referring initially to Figure 1, there is shown by way of background a water meter which is presently commercially available from Kent Meters Limited. Detailed description is not felt to be necessary but it will be seen that the arrangement generally consists of a lower housing 10; a chamber 12; a piston 14; a shutter 16; a top plate 18; a register 20 and an upper housing 22.

Turning to Figure 2, and first to Figure 2a), a half-crescent shaped inlet port 24 is provided in the base of the chamber 12 and is open to the interior of the piston 14. In-flowing water causes the piston to start its semi-rotary oscillatory movement, sliding on the dividing shutter 16. Simultaneously, exhaust water in the remaining part of the piston is being expelled through the half crescent-shaped outlet port 26 in the top plate 18.

In the position shown in Figure 2b), the piston has moved around a quarter of its path and the in-flowing water continues filling the interior of the piston 14 and commences filling the region between the shutter 16 and the upstream side of the sealing line between the piston 14 and the chamber 12. Water downstream of the sealing line begins to be expelled

through the outlet port 26.

Figure 2c) shows the halfway position in which the interior of the piston 14 is cut off from both ports.

In the three-quarter position shown in Figure 2d), the interior of the piston is opening to the inlet port 24 for the beginning of another cycle.

It will be particularly evident from Figure 2 how grit, or any other solid particulate matter carried in the flowing water, is likely to become trapped in the sweeping movement between the piston 14 and the chamber 12. This will increase friction and may lead to abnormal wear of the engaging surfaces. The manner in which this problem is dealt with by the present invention will now be described.

Turning to Figure 3, there is shown a piston 12 having a cylindrical piston wall 30; an integral, perforate bottom plate 32; and a register-driving boss 34. The piston wall 30 has an aperture 36 shaped to receive the shutter 16 in a combined sliding and rocking motion. The plate 32 has a cut-away 38 for the same purpose.

Around substantially the entire outer periphery of the piston wall 30, there are provided grooves 40. The cross-sectional shape of these grooves is seen most easily in the increased scale of Figure 4. The grooves are

parallel to the cylindrical axis and, apart from the region about the aperture 36, are equally spaced. As is apparent from Figure 5, the grooves 40 extend over the major portion of the axial length of the piston 12, leaving a land 42 which ensures that there is no direct leakage path from the inlet to the outlet port.

Referring to Figure 6, it can be understood how the grooves 40 meet the object of this invention. It will first be noted that there is a substantial reduction in the contact area between the piston 14 and the chamber 12, with a corresponding reduction in the probability of particles becoming trapped. Particles falling within the grooves 40 will be transported without difficulty across the line of sealing engagement. Moreover, the shape of the grooves, together with the oscillatory motion of the piston, will create local transverse turbulences (as indicated at 50 in Figure 6), tending to maintain the particles in suspension.

It is observed that the presence of the grooves 40 does not prevent a satisfactory seal being maintained between the piston 14 and the chamber 14. The multiple groove structure along the piston circumference creates a series of compression and expansion effects which dissipate kinetic energy in the above-mentioned transverse turbulences. This reduces the pressure drop between the inlet and the outlet and thus reduces leakage. This is achieved without a loss of torque and without reducing the ability of the piston to drive even a high drag register.

Looking at Figures 7 and 8, it is seen that a relief slot 60 is provided around the point at which the shutter 16 enters the wall of the chamber 12. In a preferred feature of this invention, the relief slot 60 - at the downstream side - is extended to communicate with the outlet port 26. Whilst this is shown for clarity with a full line in Figure 7, it is provided in the bottom of the chamber. Inlet port 24 is provided in the top of the chamber. This enables all water to be freely exhausted from the downstream side of the chamber grooves 40, avoiding an accumulation of grit inside the chamber.

The described water meter has the following advantageous features:-

i) any solid matter is likely to remain in suspension, by virtue of the described turbulence.

ii) there is a "virtual" increase in the gap between the piston and the chamber, without opening a leakage path;

iii) the water in the increased gap is kept steadily moving;

iv) a throughway is created for particles to be flushed out through the outlet port, and

v) entrapped water has a cushioning effect reducing friction and lowering wear.

It should be understood that this invention has been described by way of example only and a wide variety of modifications are possible without departing from the scope of the invention. The number, shape and position of the grooves or other recesses in the piston will be chosen to suit the geometry of any particular meter. The described grooves in the piston may be replaced with grooves or other recesses in that part of the chamber wall which is in sealing engagement with the piston. This alternative is illustrated in Figure 9 which shows a chamber 120 having a chamber wall 121 provided with circumferentially spaced, axially directed grooves 122. The manner in which these grooves 122 provide a pathway for suspended particulate matter is analogous to the described behaviour of a grooved piston. If, as a design choice, the necessary metering seal is formed not with the outer chamber wall but with the inner chamber hub 124, then grooves may be formed in that hub as shown at 126. Usually, grooves will be formed only at that interface which provides the metering seal; the running gap at the other interface will be increased to the extent that no problem arises with particulate matter.

The further alternative exists, of course, of providing grooves or other recesses in the piston wall which runs on the hub 124, rather than on the hub itself.

The inlet and outlet ports need not necessarily lie at opposite axial ends of the chamber and an arrangement of recesses significantly different from that described may be required to provide the desired passage of solid matter across the seal. The inlet and outlet ports may, for example, be spaced circumferentially of the chamber. Such an arrangement is shown in Figures 10 and 11. Here, the chamber 212 is provided with a radially directed outlet port 226 and a circumferentially offset inlet port which is not seen in the drawing. The piston 214 is provided with grooves 240 in the outer periphery of the piston wall 230. The operation of the piston 214, together with the shutter 216, is analagous with the arrangement described above. For manufacturing convenience, grooves 242 are provided also in the inner surface of the piston wall 230.

A flushing well 250 is provided in the chamber 212 to collect particulate matter transported around the swept volume in the piston recesses. As shown in Figure 11 this flushing well 250 communicates with the outlet port 226.

Claims

1. A water meter comprising a cylindrical chamber having a fluid inlet port and a fluid outlet port and a piston eccentrically disposed within the chamber and having a cylindrical piston wall in sealing engagement with the cylindrical wall of the chamber such that generally cicumferential movement of the piston relative to the chamber sweeps a fixed volume of water passing from the inlet to the outlet port, characterised in that one of the said cylindrical piston wall and the said cylindrical chamber wall is provided with a plurality of recesses spaced circumferentially, each recess opening to the chamber so as to provide a pathway for particulate matter carried by the water, without significant impairment of said sealing engagement.

2. A meter according to Claim 1, wherein flush channel means communicate between said pathway and the fluid outlet port.

3. A meter according to Claim 2, wherein said channel means comprise a flush channel extending axially of the chamber.

4. A meter according to Claim 2, wherein said chanel means comprise a flush well extending radially of the chamber.

5. A meter according to Claim 1, wherein said recesses comprise axially directed grooves.

6. A meter according to Claim 5, wherein said grooves are formed in a radially outwardly directed surface of the piston.

7. A meter according to Claim 5, wherein said grooves are formed in a radially inwardly directed surface of the chamber.

8. A meter according to any one of the preceding claims, wherein the recesses extend over at least fifty percent of the corresponding surface in said sealing engagement.

9. A meter according to Claim 8, wherein the recesses extend over about seventy percent of said surface.

10. A portable water meter in accordance with any one of the preceding claims.

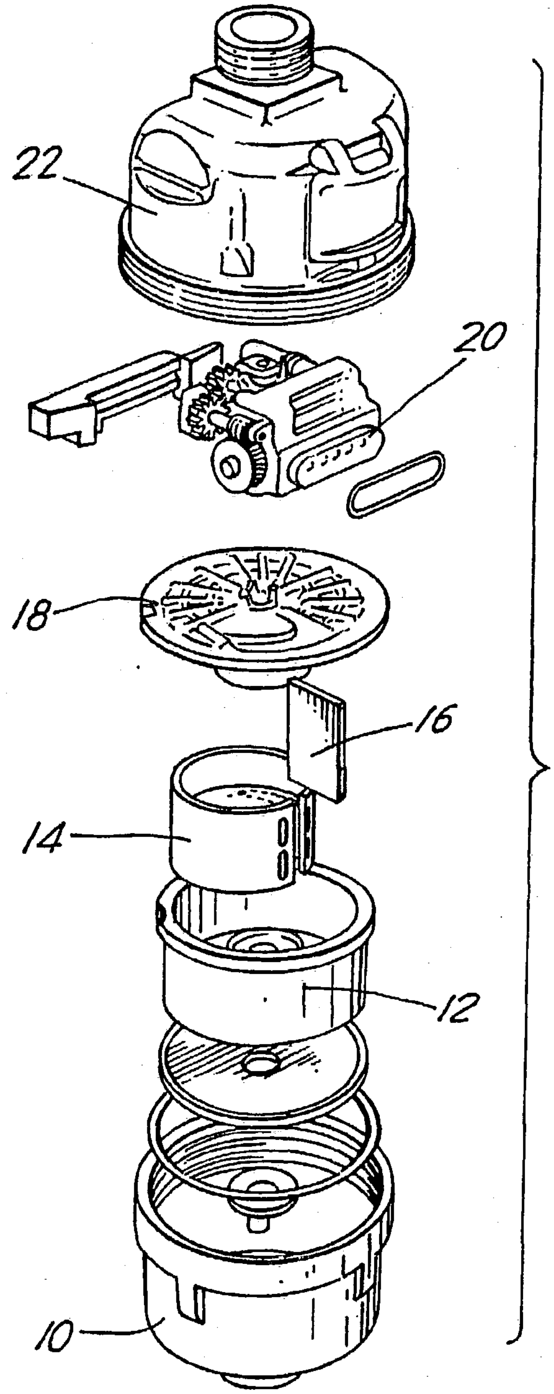

FIG.1

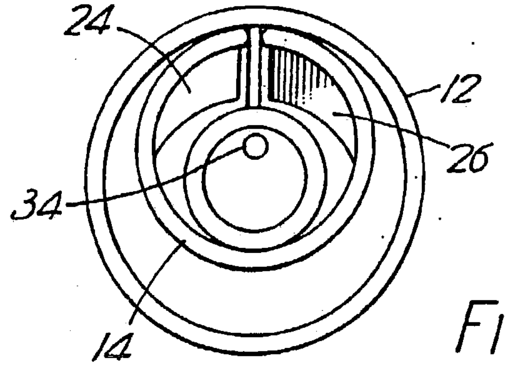

FIG. 2(a)

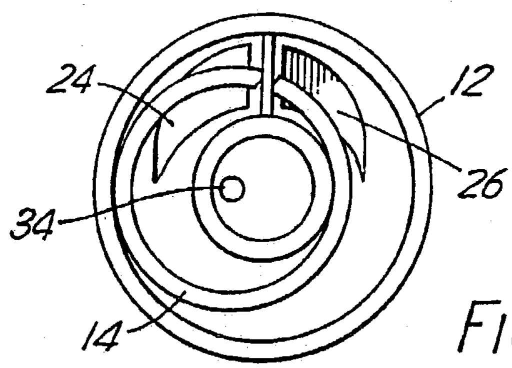

FIG. 2(b)

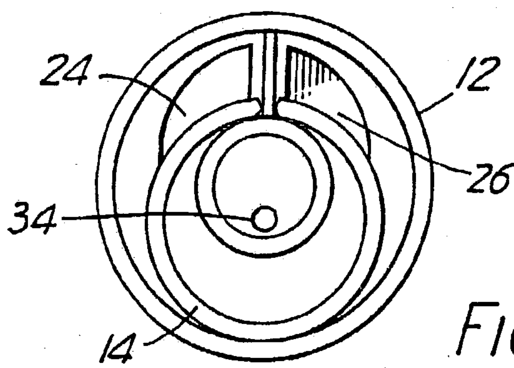

FIG. 2(c)

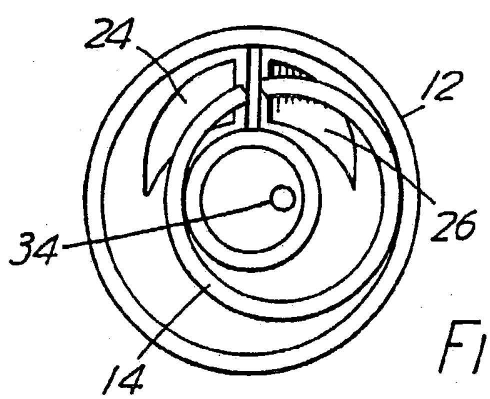

FIG. 2(d)

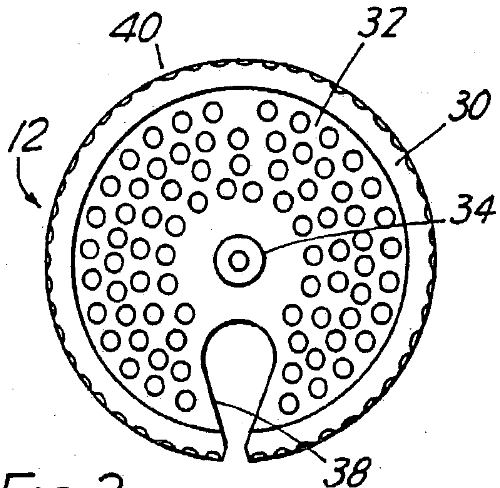

FIG. 3

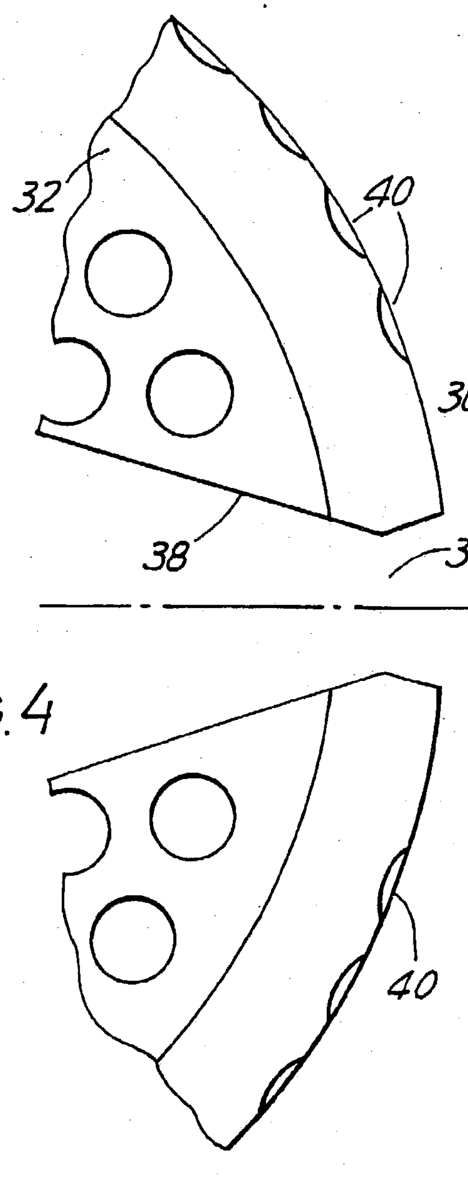

FIG. 4

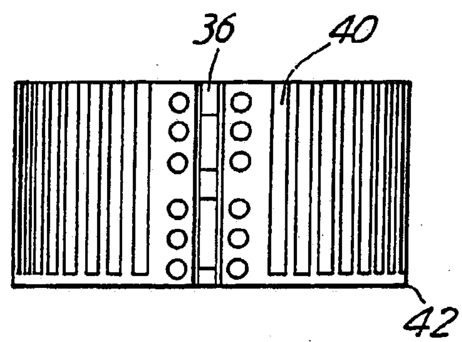

FIG. 5

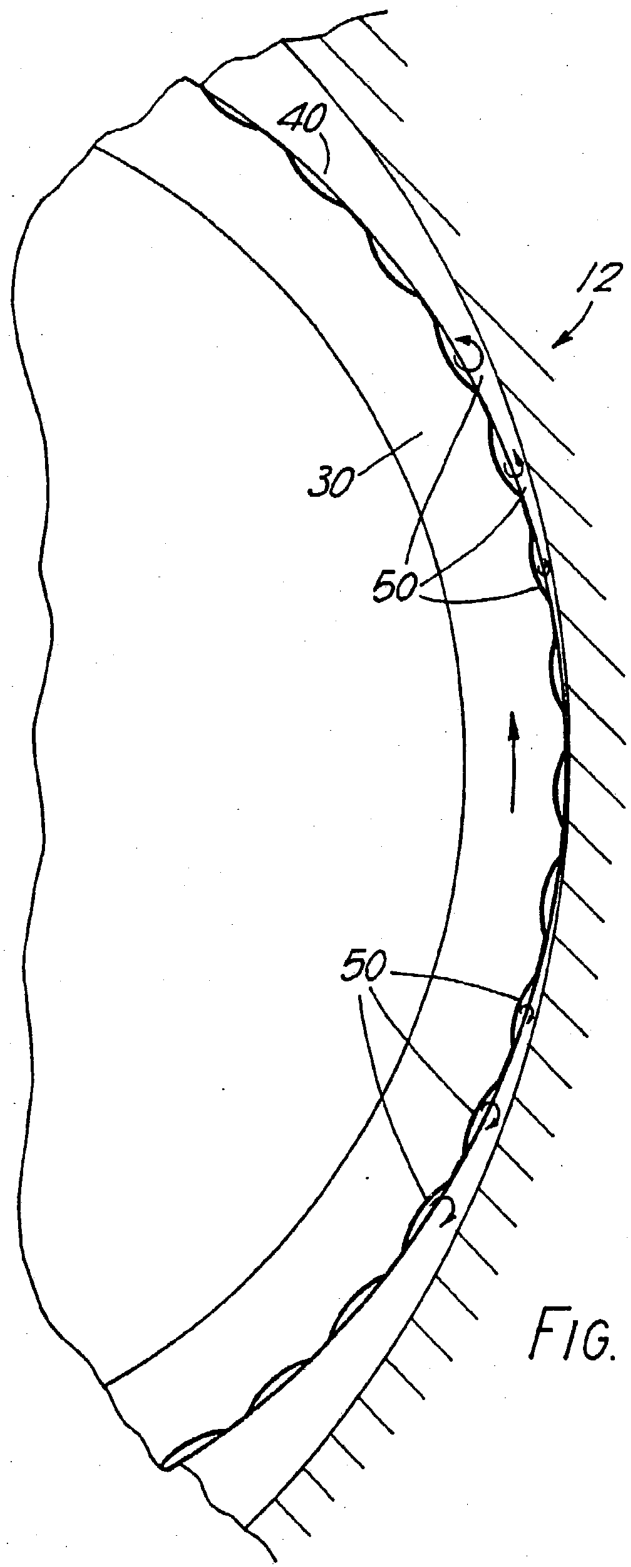

FIG. 6

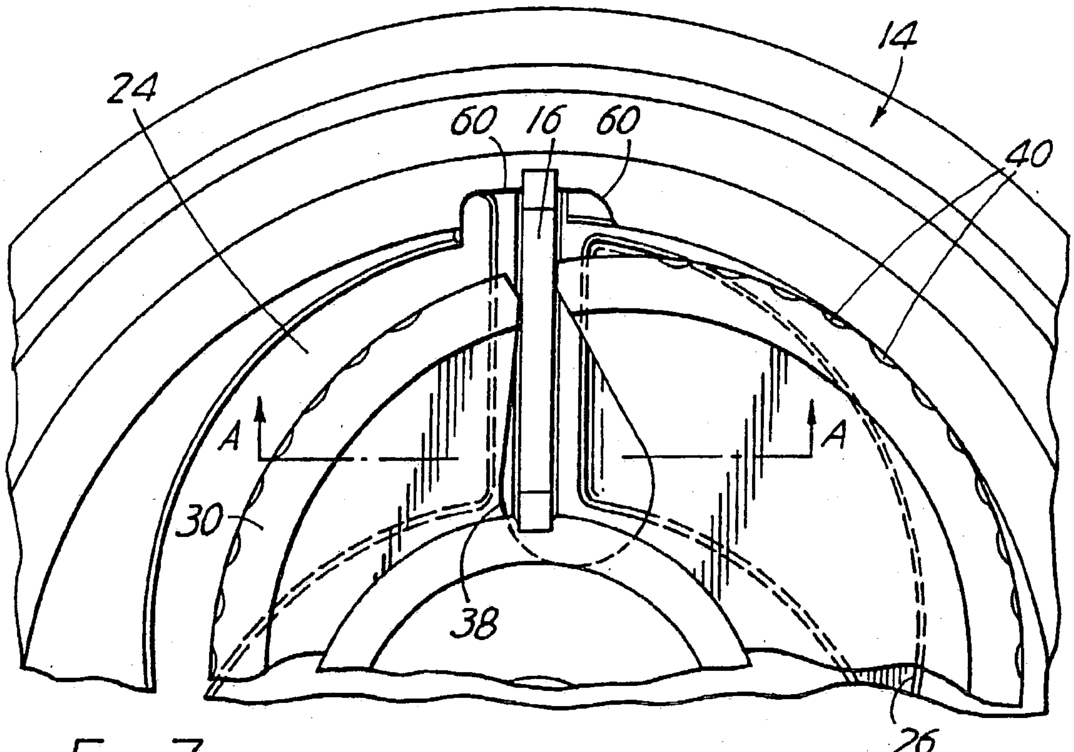

FIG. 7

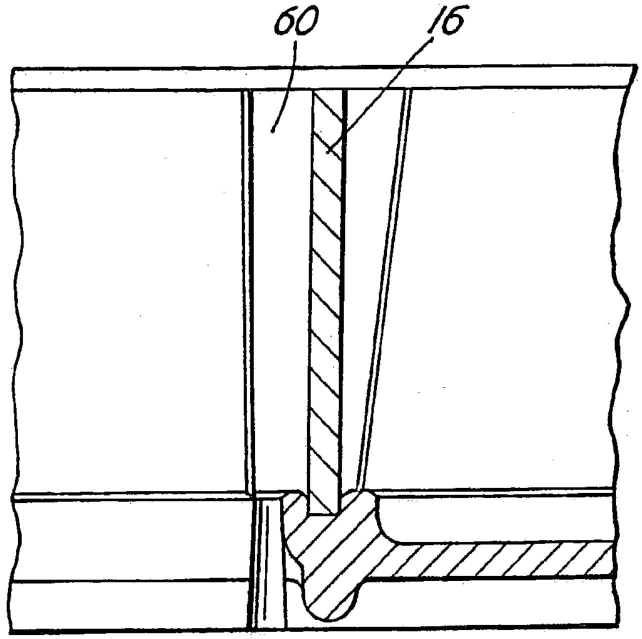

FIG. 8

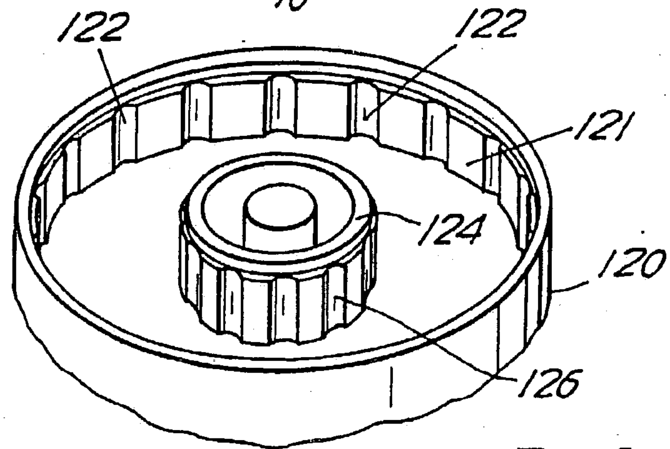

FIG. 9

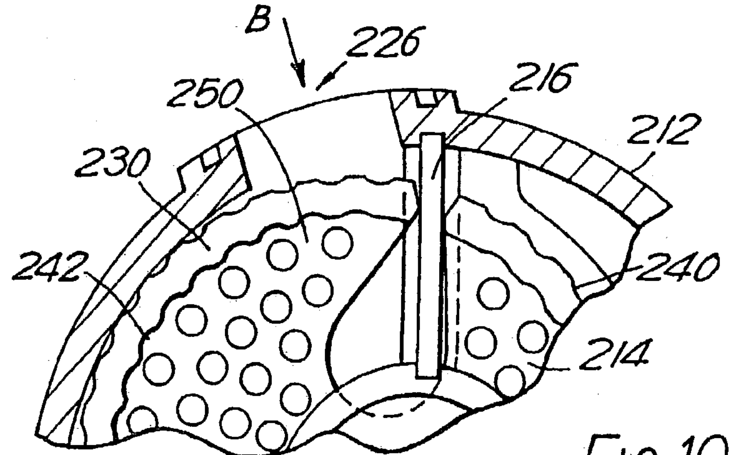

FIG. 10

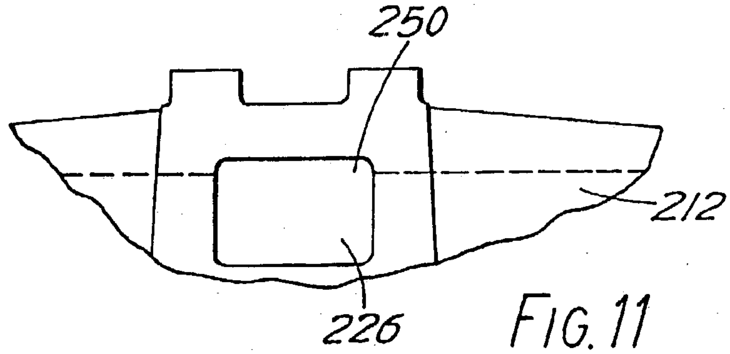

FIG. 11

International Application No PCT/GB 93/00891

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 G01F3/08

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	G01F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	DE,C,968 398 (BOPP & REUTHER) 30 January 1958 see page 1, line 1 - page 2, line 43; claim 1; figures 1-3	1-10
X	GB,A,404 321 (GEORGE KENT, LTD) 12 January 1934 see figure 2	1,5
X	FR,A,967 801 (ELECTRICITY METER MANUFACTURING COMP.) 13 November 1950 see figures 5,6	1,5
A	FR,A,830 175 (WASSERMESSER-PATENT-GESELLSCHAFT) 22 July 1938 see page 2, line 16 - page 3, line 7; figures 1-5	1-10

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
21 JULY 1993	09.08.93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	HEINSIUS R.

2

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

GB 9300891
SA 73464

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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GB-A-404321		None	
FR-A-967801		None	
FR-A-830175		None	

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